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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 09/652,533 | 08/31/2000 | Gurtej S. Sandhu | MI22-1385 | 4487 |
| 21567 | 7590 | 03/21/2003 | | |
| WELLS ST. JOHN ROBERTS GREGORY & MATKIN P.S. 601 W. FIRST AVENUE SUITE 1300 SPOKANE, WA 99201-3828 | | | EXAMINER | |
| | | | COLEMAN, WILLIAM D | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2823 | |

DATE MAILED: 03/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|------------------------------|------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 09/652,533 | SANDHU ET AL. | |
| | Examiner W. David Coleman | Art Unit 2823 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 06 January 2003.

2a) This action is FINAL. 2b) This action is non-final.

3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1-43, 55 and 56 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) Claim(s) 55 and 56 is/are allowed.

6) Claim(s) 1-43 is/are rejected.

7) Claim(s) _____ is/are objected to.

8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.

10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) The proposed drawing correction filed on _____ is: a) approved b) disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.

12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) All b) Some * c) None of:
1. Certified copies of the priority documents have been received.
2. Certified copies of the priority documents have been received in Application No. _____.
3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) The translation of the foreign language provisional application has been received.

15) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

| | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>19</u> . | 6) <input type="checkbox"/> Other: |

DETAILED ACTION***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on January 6, 2003 has been entered.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Aarik et al., "Effect of growth conditions on formation of TiO₂-II films in atomic layer depositions process", Journal of Crystal Growth, vol., 181, pp. 259-264, May 1997.

3. Pertaining to claims 1, 2, 18 and 19, Aarik discloses a deposition method as claimed.

Aarik teaches a deposition method comprising:

at a first temperature (425 °C), contacting a substrate with a surface activation agent (TiCl₄) and adsorbing a first layer over the substrate; and

at a second temperature greater than the first temperature (700 °C), contacting the first layer with a first precursor (H₂O) and chemisorbing a second layer at least one monolayer thick over the substrate.

4. Pertaining to claim 26, Aarik teaches a deposition method comprising:
 - adsorbing a surface activation agent over a substrate, at least an outer surface of the substrate being at a first temperature less than a chemisorption temperature of the agent;
 - altering a temperature of at least a portion of the substrate;
 - chemisorbing a monolayer of a first compound over the substrate, at least an outer surface of the substrate being at a second temperature greater than the first temperature, and substantially displacing the agent from over the substrate; and
 - chemisorbing a monolayer of a second compound on the first compound monolayer.
5. Pertaining to claims 3, 4, 20, 21, 28 and 29, Aarik teaches wherein the surface activation agent comprises a metal halide comprising TiCl₄.
6. Pertaining to claim 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 22, 23, 24, 25, 27 and 30 Aarik teaches wherein the first temperature is less than a chemisorption temperature of the surface activation agent on the substrate (see Introduction, second paragraph). The substrate comprises a bulk semiconductor wafer (111 silicon, Experimental procedure). The surface activation agent is the same as the first precursor, which consist of a monolayer. The first layer is substantially displaced from over the substrate during chemisorbing the second layer, hence (TiO₂ formation).

Claim Rejections - 35 USC § 103

Art Unit: 2823

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aarik et al., "Effect of growth conditions on formation of TiO₂-II films in atomic layer depositions process", Journal of Crystal Growth, vol., 181, pp. 259-264, May 1997, as applied to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 and 30 above, and further in view of Sherman, U.S. Patent 5,916,365.

9. Aarik discloses a semiconductor process substantially as claimed as discussed above. However, Aarik fails to teach contacting a second layer with a second precursor and chemisorbing a third layer at least one monolayer thick on the second layer, forming a chemisorption product of the first and second precursors comprising a deposition material. Sherman teaches contacting the second layer with a second precursor and chemisorbing a third layer at least one monolayer thick on the second layer, forming a chemisorption product of the first and second precursors comprising a deposition material. See **Example 3** of Sherman, where three or more elements such as an oxynitrides by sequentially growing an oxide and then growing a nitride is disclosed. In view of Sherman, it would have been obvious to one of ordinary skill in the art to incorporate the semiconductor process of Sherman into the Aarik semiconductor process because the provides growing oxynitrides by atomic layer deposition (column 8, lines 9-15).

10. Claims 31, 34, 36, 38, 39, 40, 41, 42 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aarik et al., "Effect of growth conditions on formation of TiO₂-II films in atomic layer depositions process", Journal of Crystal Growth, vol., 181, pp. 259-264, May 1997, in view of Doering et al., U.S. Patent 6,174,377 B1.

11. Pertaining to claims 31 and 34, Aarik discloses a semiconductor process substantially as claimed.

12. A deposition method comprising:

contacting a bulk semiconductor wafer with a cooling medium (purging gas via adsorption trap cooled down to 100K) to establish at least an outer surface with a surface activation agent and adsorbing a first layer on the wafer, the initial temperature being less than a chemisorption temperature of the agent;

contacting the first layer with a deposition precursor and chemisorbing a second layer at least one monolayer thick over the wafer. However, Aarik fails to disclose placing a wafer on a heated wafer chuck. Doering teaches placing a wafer on a heated wafer chuck, see **FIG. 10B** of Doering where wafers(not shown) are heated. In view of Doering, it would have been obvious to one of ordinary skill in the art to place wafers on a heated chuck because the Examiner believes that heating is required to form an oxide film.

13. Pertaining to claim 36, Doering discloses wherein there are multiple chambers for the fabrication of atomic layer deposition films (see **FIG. 10A** of Doering).

Pertaining 38, 39, 40, 41, 42 and 43 Aarik teaches wherein the first layer enhances a chemisorption rate of the deposition precursor compared to the wafer without the surface

activation agent adsorbed thereon (i.e., it is well known that monolayer of oxygen are always forming on silicon because of there strong bond and by heating the wafer, the process reduces that particular chemisorption rate). Aarik also discloses a metal halide comprising TiCl₄ wherein the surface activation agent is the same as the deposition precursor. Aarik discloses wherein the second layer consist essentially of a monolayer.

14. Pertaining to claims 32, 33, 35 and 37, the combined teaches discloses a semiconductor process substantially as claimed. However, Aarik fails to disclose elevating the wafer over the heated wafer chuck, placing the wafer on a cooled wafer chuck different from the heated wafer chuck by robotic linear translation. Doering teaches a method wherein elevating the wafer over the heated wafer chuck, placing the wafer on a cooled wafer chuck different from the heated wafer chuck by robotic linear translation. See FIGS. 2-23 of Doering where a processing station adaptable to standard cluster tools has a robotic linear translation for different wafer chucks (i.e., one for heating and one for cooling). In view of Doering, it would have been obvious to one of ordinary skill in the art to incorporate the semiconductor apparatus of Doering in the teachings of Aarik, for the processing of ALD films (see Title).

Allowable Subject Matter

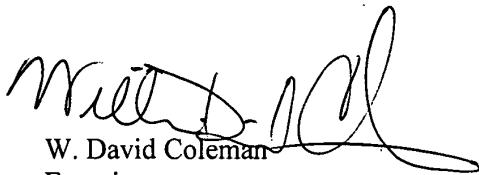
Claims 55 and 56 allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 703-305-0004. The examiner can normally be reached on 9:00 AM-5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7721 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



W. David Coleman
Examiner
Art Unit 2823

WDC
March 18, 2003